

CLAIMS:

1. An electron cyclotron resonance type ion source comprising:
 - a hollow housing, which functions as an anode and is maintained under high voltage, said housing being made of a non-magnetic material;
 - a source of electric power having a negative terminal and a positive terminal, said positive terminal being connected to hollow housing for applying said high voltage, said negative terminal of said source of electric power being grounded,
 - the interior of said sealed hollow housing forming a plasma-confining cavity having an axial length;
 - permanent magnetic field generation means for generating a permanent magnet field within said plasma-confining cavity for confining a plasma, formed in said plasma-confining cavity, in a radial inward direction;
 - microwave energy generation means with a frequency satisfying a condition of electron-cyclotron resonance consumption of microwave energy by said plasma, said microwave energy generation means comprising at least two individual microwave generators and at least two microwave energy pumping units, respectively, for supplying microwave energy into said plasma-confining cavity, said microwave energy having a frequency required for said condition of electron-cyclotron resonance consumption for electrons of said plasma;
 - at least one elongated window unit extending in the direction of said axial length, said elongated window unit being transparent to said microwave energy of said microwave energy pumping units for passing said microwave energy to said plasma-confining cavity, said at least one elongated window unit having means for sealing said plasma-confining cavity;
 - RF energy supply means for supplying RF energy to said plasma-confining cavity;

means for the supply of a gaseous medium into said sealed hollow housing; and

ion-beam formation and extraction means for forming an ion beam and extracting said ion beam from said plasma.

2. The ion-beam source of Claim 1, further comprising means for cleaning said at least one elongated window unit from contamination.
3. The ion-beam source of Claim 1, wherein said at least one elongated window unit comprises a metal rod of a round cross section having a through window extending in a direction of said axial length, and means for sealing said plasma-confining cavity comprises a reciprocating and rotating tubular body which is transparent to said microwave energy and into which said metal rod is slidingly inserted.
4. The ion-beam source of Claim 2, wherein said means for cleaning comprises a mechanism for rotating said tubular body and reciprocating thereof in said direction of said axial length, and means for removing contaminants from the surface of said tubular body.
5. The ion-beam source of Claim 4, wherein said means for removing contaminants comprise a sand-blast mechanism.
6. The ion-beam source of Claim 1 wherein said gaseous medium is a carrier gas that contains particles of a material for implantation.
7. The ion-beam source of Claim 1, wherein said gaseous medium is a neutral gas and wherein said ion-beam source further comprises at least one RF sputtering magnetron connected to said RF energy supply means.

8. The ion-beam source of Claim 7, further comprising means for cleaning said at least one elongated window unit from contamination.
9. The ion-beam source of Claim 7, wherein said at least one elongated window unit comprises a metal rod of a round cross section having a through window extending in said direction of said axial length, and means for sealing said plasma-confining cavity comprises a reciprocating and rotating tubular body which is transparent to said microwave energy and into which said metal rod is slidingly inserted.
10. The ion-beam source of Claim 9, wherein said means for cleaning comprises a mechanism for rotating said tubular body and reciprocating thereof in said direction of said axial length, and means for removing contaminants from the surface of said tubular body.
11. The ion-beam source of Claim 9, wherein said means for removing contaminants comprise a sand-blast mechanism.
12. The ion-beam source of Claim 7, wherein said at least one RF sputtering magnetron comprises a magnetic field generation means and a magnetron sputtering target made from a sputterable material supplied to said gaseous medium.
13. The ion-beam source of Claim 1, wherein said at least two individual microwave generators comprise a plurality of individual microwave generators arranged sequentially in alternating order on opposite sides of said hollow housing with shift in said direction of said axial length, said at least two microwave energy pumping units comprising a plurality of microwave energy pumping .

14. The ion-beam source of Claim 13, wherein said gaseous medium is a neutral gas and wherein said ion-beam source further comprises at least one RF sputtering magnetron connected to said RF energy supply means.
15. The ion-beam source of Claim 13, further comprising means for cleaning said at least one elongated window from contamination.
16. The ion-beam source of Claim 13, wherein said at least one elongated window unit comprises a metal rod of a round cross section having a through window extending in said direction of said axial length, and means for sealing said plasma-confining cavity comprises a reciprocating and rotating tubular body which is transparent to said microwave energy and into which said metal rod is slidingly inserted.
17. The ion-beam source of Claim 16, wherein said means for cleaning comprises a mechanism for rotating said tubular body and reciprocating thereof in said direction of said axial length, and means for removing contaminants from the surface of said tubular body.
18. The ion-beam source of Claim 17, wherein said means for removing contaminants comprise a sand-blast mechanism.
19. The ion-beam source of Claim 14, wherein said at least one RF sputtering magnetron comprises a magnetic field generation means and a magnetron sputtering target made from a sputterable material supplied to said gaseous medium.
20. The ion-beam source of Claim 1, wherein said ion-beam formation and extraction means extend along said direction of said axial length of said plasma-confining cavity.

21. The ion-beam source of Claim 20, wherein said ion-beam formation and extraction means comprise a two-electrode lateral ion-extraction lens which is formed in said hollow housing and has a first end that projects into said housing towards said plasma-confining cavity and a second end that projects radially outwardly from said hollow housing, said two-electrode lateral ion-extraction lens having a plasma-extraction slit open into said plasma-confining cavity and extending substantially along entire length of said hollow housing in a direction said axial length, said two-electrode lateral ion-extraction lens having a first electrode which comprises a part of said housing and is under potential of said anode and a second electrode which is located inside said first electrode is under a ground potential.
22. The ion-beam source of Claim 21, wherein said at least two individual microwave generators comprise a plurality of individual microwave generators arranged sequentially in alternating order on opposite sides of said hollow housing with shift in said direction of said axial length, said at least two microwave energy pumping units comprising a plurality of microwave energy pumping units and each of said microwave energy pumping units of said plurality comprising at least one reactive element required for adjusting energetic link between a respective individual microwave generator of said plurality and said plasma-confining cavity.
23. The ion-beam source of Claim 22, wherein said gaseous medium is a neutral gas and wherein said ion-beam source further comprising at least one RF sputtering magnetron connected to said RF energy supply means.
24. The ion-beam source of Claim 23, further comprising means for cleaning said at least one elongated window unit from contamination.

25. The ion-beam source of Claim 24, wherein said at least one elongated window unit comprises a metal rod of a round cross section having a through window extending in said direction of said axial length, and means for sealing said plasma-confining cavity comprises a reciprocating and rotating tubular body which is transparent to said microwave energy and into which said metal rod is slidingly inserted.
26. The ion-beam source of Claim 25, wherein said means for cleaning comprises a mechanism for rotating said tubular body and reciprocating thereof in said direction of said axial length, and means for removing contaminants from the surface of said tubular body.
27. The ion-beam source of Claim 26, wherein said means for removing contaminants comprise a sand-blast mechanism.
28. A method of generating an ion beam for use in an ion implanter, comprising the steps of:
 - providing an ion-beam source comprising a sealed plasma-confining cavity having an axial length, evacuating means for evacuating said sealed plasma-confining cavity, gaseous medium supply means for supplying a gaseous medium into said plasma-confining means, magnetic field generating means for generating a magnetic field in said sealed plasma-confining cavity, microwave energy pumping means for pumping a microwave energy into said sealed plasma-confining cavity, at least one elongated window unit extending substantially along said axial length of said plasma-confining cavity and sealing said plasma-confining cavity, said at least one elongated window unit being transparent to said microwave energy generated by said microwave energy pumping means, RF energy pumping means for pumping RF energy into said plasma-

confining cavity, and means for cleaning said at least one elongated window unit from contaminants;

evacuating said sealed plasma-confining cavity by said evacuating means;

supplying a gaseous medium into said sealed plasma-confining cavity by said gaseous medium supply means;

generating a magnetic field in said sealed plasma-confining cavity by said magnetic field generating means;

pumping a microwave energy into said sealed plasma-confining cavity by said microwave energy pumping means via said at least one elongated window unit;

pumping RF energy into said plasma-confining cavity by said RF energy pumping means;

developing conditions of electron-cyclotron resonance consumption of said microwave energy in said sealed plasma-confining cavity;

generating a gaseous plasma in said gaseous medium in said sealed plasma-confining cavity;

extracting ions from said plasma in a radial outward direction of said plasma-confining cavity and forming an ion beam for use in said ion implanter;

and cleaning said elongated windows from said contaminants.

29. The method of Claim 28, further comprising a step of maintaining uniform density of said ion beam in the direction of said axial length by adjusting an energetic link between said microwave energy pumping means and said plasma-confining cavity in the direction of said axial length.

30. The method of Claim 28, further providing said ion-beam source with at least one RF sputtering magnetron having a target of a sputterable material suitable for implantation with the use of said ion implanter, said gaseous medium comprising a neutral gas, said method further comprising the steps of supplying RF energy to said RF sputtering magnetron, sputtering said sputterable material to form sputtered particles, supplying said sputtered particle into said plasma, ionizing said sputterable particles, and extracting an ion beam from said plasma for use in said ion implanter.